Space Weather Technical Forecast

Issued on Saturday, 20 July 2024 at 13:28 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Isolated M-class flares likely. Chance of G1 Minor Storms day 1 and day 4 (20 & 23 Jul).

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Moderate activity through the last 24 hours with three M-flares observed. Peak flare was M2.0 at 19/1806 UTC from AR3751 near south-centre disk. There are fifteen sunspot regions on the disc. The largest and most complex region on the disc remains AR3751, although this has seen some reduction in penumbral area around the intermediate and trailing spots, therefore the delta is becoming increasingly weakly connected in the central portion. Nearby AR3761, to the east of AR3751 is showing signs of slight growth in the leading portion an consolidation of spots here. It likely has some influence on the magnetic structure of AR3751 with the potential to bring additional instability to the southern centre disk, as large magnetic looping is observed between these regions. The only other region of note is AR3759 in the southwest, now with intermediate spot development. Two new simple mature and stable regions are apparent near the southeastern limb, and a couple spots have faded to pores or plage near the western limb.

Two filament eruptions were observed off the south-centre late on 19 Jul, with subsequent CMEs. The second of which from the more northerly eruption may have an Earth-directed component, with an arrival at Earth early 23 Jul most probable.

Solar Wind / Geomagnetic Activity: Slow wind conditions largely persisted, with minor perturbations and very small discontinuities, these indicative of weak transients, perhaps the CMEs expected within the forecast period. The solar wind speed, as measured by ACE at L1, was at background, 280-390 km/s. Density was average or below. Interplanetary magnetic field (IMF), Bt, was mostly Weak, but became briefly Moderate between 20/0815-1000 UTC, rising to a maximum of 10 nT. The north-south component, Bz, was largely positive, ranging between +6/-5nT. Phi angle was variable. Geomagnetic activity was Quiet throughout (Kp 1-2).

Energetic Particles / Solar Radiation: High energy (greater than 10 MeV) proton flux observed by GOES18 remained at Background. High energy electron flux (greater than 2MeV) observed by GOES16 was at Background. The 24-hour fluence was well below Active, with 9.31e5 integrated pfu observed at 20/0000UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Low to Moderate with further M-flares likely and a slight chance of X-class flares, mainly from AR3751, however, given the number of sunspots isolated flares are possible from across the disc.

Solar Wind /Geomagnetic Activity: Two potential weak CME arrivals may occur on day 1 (20 Jul). A further CME has the potential to arrive early day 4 (23 Jul). The large coronal hole in the northwest is not expected to have any significant influence. Consequently, aside from the potential CME arrivals day 1 and day 4 (20 and 23 Jul), background slow wind conditions are expected.

Geomagnetic activity is expected to be mostly Quiet to Unsettled, but with a chance of Active to

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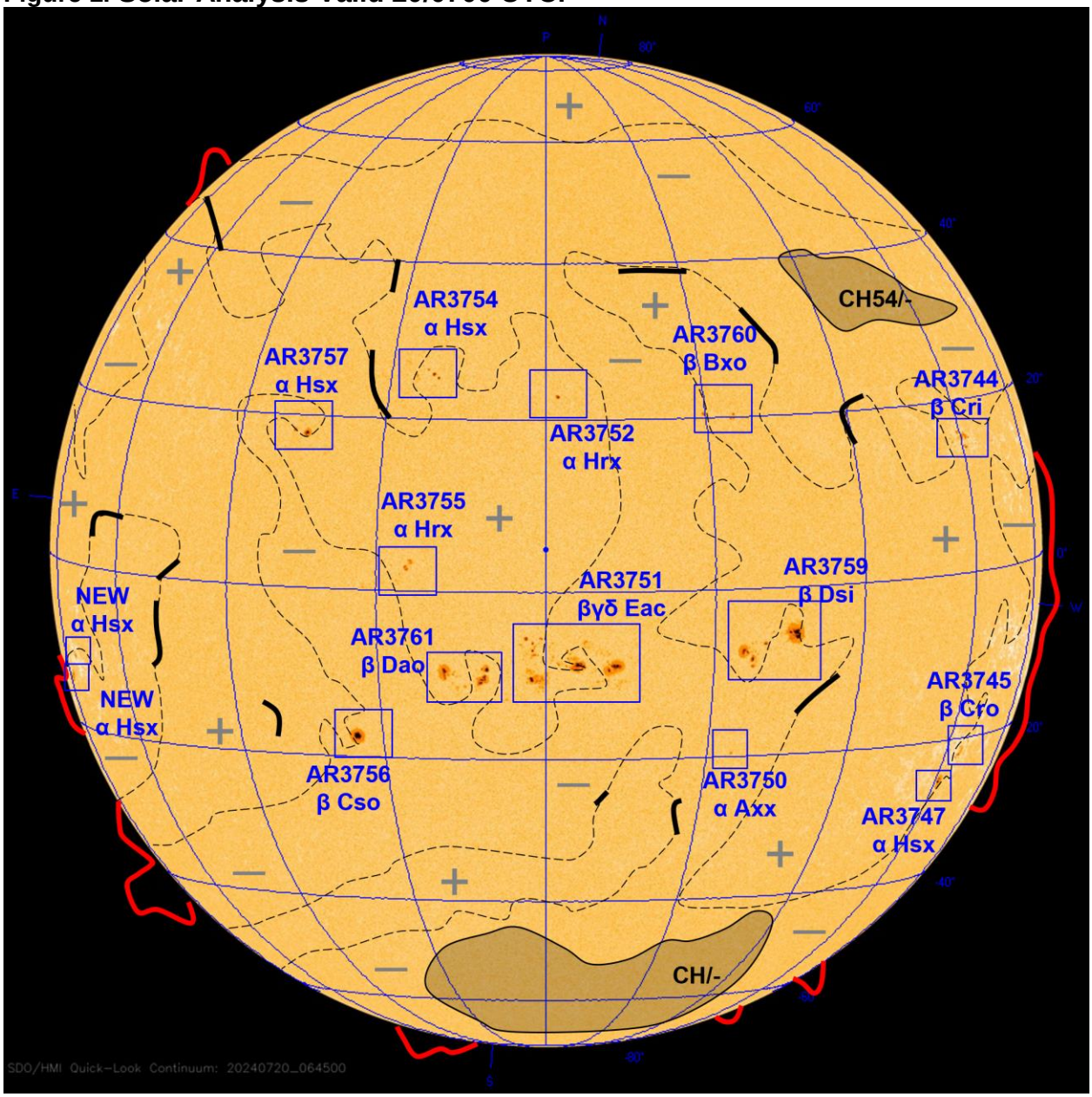
G1 Minor Storm intervals day 1 and day 4 (20 and 23 Jul) due to CME effects. A slight chance is maintained days 2 and 3 (21 and 22 Jul) should any late or early CME arrivals occur.

Energetic Particles / Solar Radiation: High energy proton flux is most likely to remain at background levels, but with a slight chance of rising above the S1/Minor Storm threshold in response to any notable flares, most likely from AR3751 as this moves into and across the western hemisphere. High energy electron flux is expected to remain at background with the associated 24 hr fluence expected to persist below Active.

Figure 1. Solar Analysis Valid 20/0700 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

There are two potential CME arrivals day 1 (20 Jul), both associated with the M1.9 flare from AR3744 on 16 Jul. The impact of these are low confidence as they are both relatively slow and weak eruptions, with the second of these perhaps largely shock, with limited material content. It is also possible that the weak transient arrival on 19 Jul was associated with one of the CMEs, however this is currently considered unlikely. A further CME has the potential to arrive early day 4 (23 Jul), from the filament eruption off the southeast disc late on 19 July. This feature can be seen as the second of two eruptions leaving to the southeast, and although faint, it may have some portion of Earth directed material.

Otherwise the main feature on the disc is the large coronal hole in the northwest. Recent minor perturbations within the solar wind parameters may be due to this feature, though any significant influence is considered unlikely. Consequently, aside from the potential CME arrivals day 1 and day 4 (20 and 23 Jul) background slow wind conditions are expected.

Geomagnetic activity is expected to be mostly Quiet to Unsettled, but with a chance of Active to G1 Minor Storm intervals day 1 and day 4 (20 and 23 Jul) due to CME effects. A slight chance is maintained days 2 and 3 (21 and 22 Jul) should any late or early CME arrivals occur.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	40	10	10	40
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
17/0334	Nil	M1.9 16/2206 AR3744	N-Centre	691 km/s	19/2200 -6/+12 hrs	Main CME ejecta Limited shock expected
17/0400	Asymmetric Halo	M1.9 16/2206 AR3744	N-Centre	530 km/s	20/1000 +/- 10 hrs	Faint halo, probably shock. May not be observable.
20/0400	Partial	Filament erutpion	S-Centre	615 km/s	23/0800 +/- 9 hrs	Northern portion of filament eruption, second of the two.

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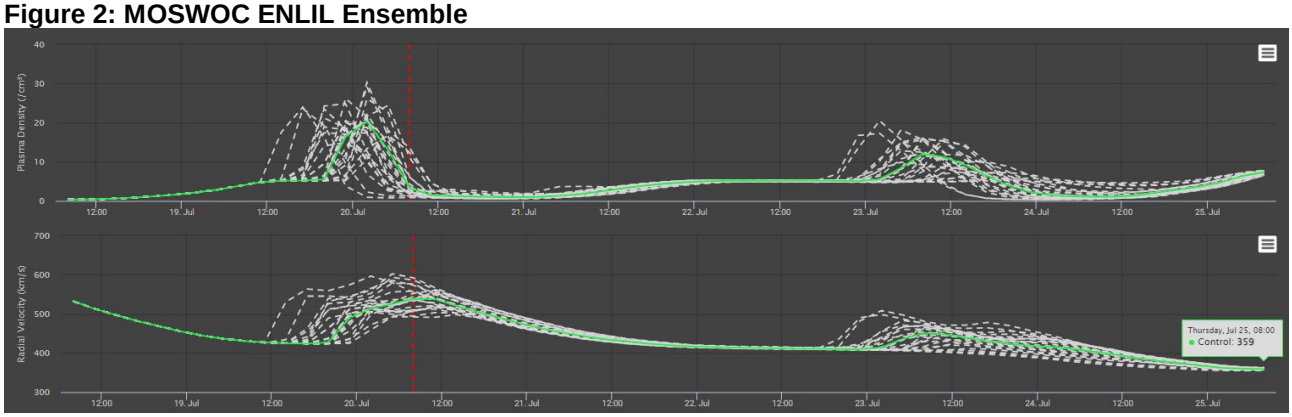
Figure 2: MOSWOC ENLIL Ensemble



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Radio Blackouts - X-Ray Flares:

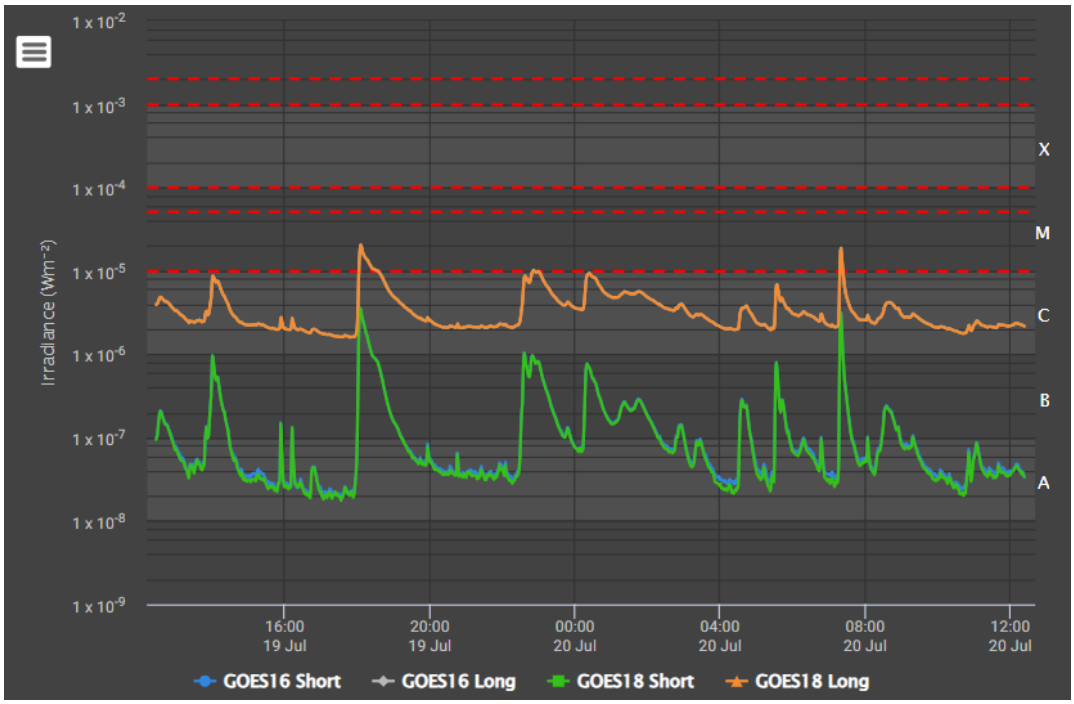
Moderate activity through the last 24 hours with three M-flares observed. Peak flare was M2.0 at 19/1806 UTC from AR3751 near south-centre disk.

There are fifteen sunspot regions on the disc. The largest and most complex region on the disc remains AR3751, although this has seen some reduction in penumbral area around the intermediate and trailing spots, therefore the delta is becoming increasingly weakly connected in the central portion. Nearby AR3761, to the east of AR3751 is showing signs of slight growth in the leading portion an consolidation of spots here. It likely has some influence on the magnetic structure of AR3751 with the potential to bring additional instability to the southern centre disk, as large magnetic looping is observed between these regions. The only other region of note is AR3759 in the southwest, now with intermediate spot development. Two new simple mature and stable regions are apparent near the southeastern limb, and a couple spots have faded to pores or plage near the western limb. All other regions are either small and/or simple.

Further M-flares are likely with a slight chance of X-class flares, mainly from AR3751.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	Yes	70	70	70	70
Very Active	R3 to R5 X Class	No	10	10	10	10

Figure 3: 24 X-ray flux



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Solar Radiation Storms - (High Energy Protons):

High energy proton flux at GOES18 is at background. There is a chance of the observed proton flux rising as a result of any significant flares, currently most likely from AR3751 in the south-centre disc. This potential slightly increases as this regions move into the better connected solar western hemisphere, where high energy protons have a greater likelihood of being towards the Earth due to the Parker Spiral.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	≥ S1	No	10	10	15	15
Very Active	≥ S3 *	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

High Energy Electrons Event (≥ 2MeV):

The high energy electron flux as observed by GOES-16 is currently at background. Given the lack of any notable fast wind enhancement being expected, and any CME influence expected to be relatively limited, background flux is forecast to persist.

The associated electron fluence is expected to persist below the Active level with MOSWOC REFM currently providing good guidance.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	≥ 2 MeV ≥ $1x10^8$	No	1	1	1	1
Very Active	≥ 2 MeV ≥ $1x10^9$	No	1	1	1	1

Figure 4: MOSWOC REFM

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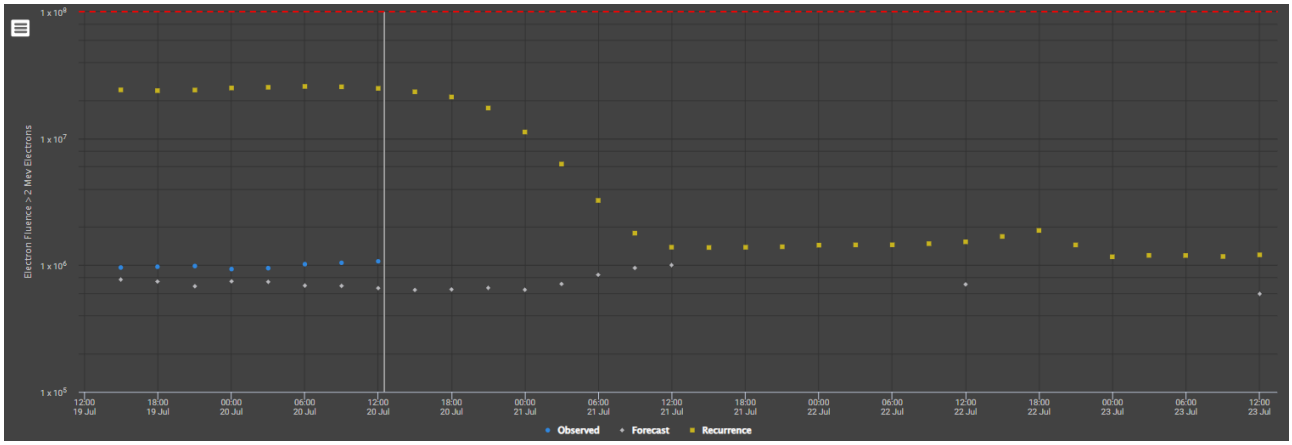

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